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# सुवाध्य मिथनोमापी यंत्र (इंटरफेरोमीटर टाईप) – विशिष्टि

*Indian Standard*

# PORTABLE METHANOMETER (INTERFEROMETER TYPE) — SPECIFICATION

ICS 17.180.99; 73.100.99

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

*March* 2000 **Price Group 2**

Mining Techniques and Equipment Sectional Committee, ME 08

## FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Mining Techniques and Equipment Sectional Committee had been approved by the Mechanical Engineering Division Council.

Under *Mine Act,* 1952, all coal mines have been declared as gassy mines. Accordingly, mine management is supposed to take precautionary measures for early detection of methane gas emmissions in mines since methane when mixed with air in specific proportions becomes explosive in nature and can cause damage to mine, men and property through explosions. The normal method of detection of methane gas emissions is through measurement of methane content of the mine atmosphere by methanometers. Many types of methanometers are available for this purpose. Most commonly used methanometer in mining industry is interferometer type portable methanometer. This methanometer works on the principle of differences in the refractive indices of the methane-air-mixture and pure dry air which causes a shift of the fringe pattern.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

# *Indian Standard*

# PORTABLE METHANOMETER (INTERFEROMETER TYPE) — SPECIFICATION

## 1 SCOPE

This Indian Standard prescribes the requirements and methods of tests for interferometer type portable optical methanometers operating on the principle of the shift of the interference fringe pattern.

## 2 REFERENCE

The following standard contains provisions which through reference in this text, constitutes provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standard indicated below:

| *IS No.* | *Title* |
|---|---|
| 9166 : 1979 | Spark test apparatus for intrinsically safe circuits |

## 3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

### 3.1 Aspirator

It is the system which supplies the sample into the instrument for detection/measurement.

### 3.2 Optical Chamber

It is an air tight cell having separate compartments for gas sample and dry air except for openings for inlet and outlet of the gas sample. These chambers are provided with sealed glass windows.

### 3.3 Scale

It is a microscale provided in the telescope to give a view of the shift of the interference fringe pattern in the background of illuminated scale.

### 3.4 Zero Adjuster

It is a device with externally projecting knob at the head. Internally, it moves a prism to bring about a shift in the interference fringe system to the desired extent when operated from outside.

### 3.5 Bulb Housing

It is a compartment where a bulb is housed as a source of light rays with the provision of its proper adjustment to obtain a clear and well defined fringe pattern.

### 3.6 Filter Tube

A cylindrical tube provided with rubber stopper at its two ends which, in turn, are provided with rubber tubes for incoming and outgoing sample. The tube itself is filled with suitable chemical reagents to remove carbon dioxide and moisture from the sample before it passes into the sample chamber.

### 3.7 Vernier Scale

It is a device intended to increase the ease and the accuracy of the reading, enabling to get fractional percentages.

### 3.8 Anti-Diffusion Tube

It is a coil of metallic tube of very fine bore fitted with the reference chamber for the combination with the external atmosphere in order to equalize the pressure inside the reference chamber and the external atmosphere without any contamination with that atmosphere.

## 4 TYPES

Interferometer type methanometers used for the detection and measurement of methane gas are divided into two types as follows based on range of operation:

| | |
|---|---|
| Type A — | Methanometers with scales reading 0 to 10 percent methane by volume. |
| Type B — | Methanometers able to read high concentration of methane with scales reading 0 to 100 percent methane by volume. |

NOTE — For measurement of lower range of methane, Type A instruments shall be used. Type B instruments shall be used only for measurement of higher range of methane.

## 5 MATERIALS AND CONSTRUCTION

### 5.1 General

**5.1.1** The methanometer shall be intrinsically safe in accordance with IS 9166. Its design shall be such that when all parts have been properly assembled, the complete unit shall be dust-proof. It shall be so designed that the drainage of power can not take place through any external part of the locked instrument, in normal use. The mass of the complete unit with all accessories shall not exceed 1.8 kg.

**5.1.2** The methanometer shall be provided with at least two separate compartments, one exclusively used for the optical system and the other for the filter tube and the battery with locking device. Alternatively, battery and the filter tube may be effectively locked in the same compartment.

### 5.2 Enclosing Case

**5.2.1** The enclosing case shall be of a material strong enough to withstand the drop test as per **7.5.1** and shall be reasonably antistatic.

**5.2.2** The external compartments shall be made of material which are non-incendiary in nature.

### 5.3 Securing Device

In order to prevent unauthorized opening of the instrument, all covers shall be so secured that they cannot be dismantled without the help of special tools designed for the purpose.

### 5.4 Checking Device

The methanometer shall be so constructed as to provide access to all points for its checking operation with respect to gas flow system, optical system, changing of the chemicals in the filter tube, replacements of battery and bulb and the glass windows in the optical chamber on the surface.

### 5.5 Contacts

Electrical contacts of micro-switches for optical chamber and vernier scale shall be of corrosion resistant material with excellent conducting properties.

### 5.6 Actuators

Provision shall be made so that the switches are operated externally by means of appropriate actuators to minimize damage to switches.

## 6 ACCURACY OF THE INSTRUMENTS

The permissible errors of the instruments are given in Table 1. At least 10 determinations shall be made in a humid atmosphere with relative humidity not less than 95 percent at each percentage. Neither the average of 10 readings nor more than two readings for each percentage, shall exceed the permissible error given in Table 1.

## 7 TESTS

### 7.1 Type Test

**7.1.1** The following shall constitute type tests:

a) Safety test in explosive methane-air mixture (*see* **7.6**);

b) Performance tests (*see* **7.7**);

c) Intrinsically safe circuit test (*see* IS 9166); and

d) Any other test as deemed necessary, may be carried out (*see* **7.8**).

**7.1.2** No sample shall fail in any of the tests.

### 7.2 Routine Test

**7.2.1** Following tests constitute routine tests:

a) Physical examination test (*see* **7.4**), and

b) Physical tests (*see* **7.5**).

**7.2.2** No sample shall fail in any of the tests.

### 7.3 Acceptance Test

**7.3.1** The following shall constitute acceptance tests and shall be carried out on three samples from each batch of 100 units or part thereof:

a) Performance test (*see* **7.7**), and

b) Additional tests, if required (*see* **7.8**).

### 7.4 Physical Examination

Each methanometers shall be examined for external finish, workmanship, zero-setting, gas flow system, optical chamber, the optical system, and the operating switches.

### 7.5 Physical Tests

**7.5.1** *Drop Test*

A dummy casing adequately loaded to represent the mass of the instrument when dropped from a height of 1.2 m on a concrete floor shall not get damaged to such an extent as to show cracks traversing the full thickness of the case material or jeopardize the securing device of the instruments.

**Table 1 Permissible Calibration Errors**

(*Clause* 6)

| Type | Permissible Errors | |
|---|---|---|
| | Range of Percentage of Methane | Error |
| (1) | (2) | (3) |
| A | 0 - 2 | ± 0.1 percent methane |
| | Beyond 2 and upto 10 | ± 10 percent of true value |
| B | 1 - 20 | ± 2 percent methane or 20 percent of true value whichever is lower |
| | 20 - 100 | ± 5 percent methane or 10 percent of true value whichever is lower |

**7.5.2** *Tests for the Adequacy of the Aspirating System*

After sampling 7.5 percent methane-air-mixture by volume for Type A and 85 percent methane-air-mixture for Type B, the methanometer shall indicate 0 reading within 10 seconds by aspirating fresh air.

### 7.6 Safety Test in Explosive Methane-Air-Mixture

The methanometer shall be kept in a chamber containing 7.5 to 8.5 percent methane-air-mixture and arrangement made for operating the methanometer in that atmosphere. Five tests shall be made. There shall be no ignition of the external atmosphere in any test.

### 7.7 Performance Test

**7.7.1** *Tests for Accuracy in Stagnant Atmosphere*

Two methanometers shall be subjected to this test with several methane-air-mixtures. The percentage of methane by volume in methane-air-mixture shall vary at intervals of 0.5 percent for Type A methanometers and 5 percent for Type B methanometers whole range of the scale of methanometers shall be covered by tests. Differences between the instrument reading and the concentration of methane of the standard sample shall not exceed the limits specified in **6.1**.

**7.7.2** *Test for Stability of Zero-setting*

The instrument after adjustment of zero, shall be left at laboratory temperatures between 25°C and 30°C for a period of 24 hours. The test shall be repeated five times. Zero-shift shall not be more than ± 0.1 percent by volume.

**7.7.3** *Test for Change of Zero-reading with Temperature Change*

**7.7.3.1** The zero position shall be set at the room temperature and the instrument shall be kept in an air oven maintained at 50°C. The shift of zero must not be more than 0.1 percent per 10°C at the end of 1 hour. The instrument shall also be kept for one hour at 0°C. The shift of '0' shall not be more than 0.1 percent per 10°C at the end of one hour.

**7.7.3.2** The grease used in the glass windows of the optical chamber for sealing shall also be checked after the test specified in **7.7.3.1**. It shall not flow over the glass windows.

**7.7.4** *Effect of Diffusion at the Laboratory Temperature and Pressure*

The instrument having been set at one percent in fresh air shall be put in a chamber containing two percent methane air mixture for 24 h. The fringe shift shall not be more than 0.1 percent.

**7.7.5** *Test for Capacity of the Power Source*

All instruments fitted with a fresh (or a freshly charged) battery when used in methane-air-mixture, shall be capable of giving at least 100 readings.

### 7.8 Additional Tests

Further tests as deemed necessary may be carried out by the testing authority considering the principle of operation, the construction and the method of use of the instrument.

## 8 MARKING

**8.1** Each methanometer shall be marked with serial number, manufacturer's identification mark or trade-mark and type of the methanometer.

### 8.2 BIS Certification Marking

Each portable methanometer may also be marked with the BIS Standard Mark.

**8.2.1** The use of the Standard Mark is governed by the provisions of *Bureau of Indian Standards Act,* 1986 and the Rules and Regulations made thereunder. The details of conditions under which a licence for the use of Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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